

# SERMS

Laboratorio per lo Studio degli  
Effetti delle Radiazioni sui Materiali  
per lo Spazio

Via Pentima Bassa, 21 Terni  
05100 TR  
phone/fax: +39.0744.49.29.13

## ENVIRONMENTAL TEST REPORT

doc: STAR  
TRACKER\_THERMAL  
VACUUM CYCLING TEST  
date: 06/07/06

rev: A01

pag: 1 /17

file: ENVRPT\_ST-  
06JULY2K6

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## ENVIRONMENTAL TEST REPORT

ENVRPT\_ST-06JULY2K6

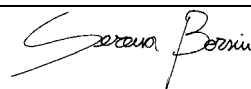
date: July 06, 2006

*signature*

test report  
prepared by:

06/07/06

Ing. S. Borsini



*Test Engineer and  
Responsible*

test report  
controlled by:

approved by:

### change record

date	change description	revision
06/07/2006	first issue	A01

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**TEST REPORT DESCRIPTION**

This document is generated by the S.E.R.M.S. Laboratory and reports on the setup, the operation and the results of the test performed on the customer Device Under Test (D.U.T.); several sections compose this report: all of them have been integrated and adapted to the specific tests performed on the D.U.T.

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### GENERAL INFORMATION

**Job Number:****Test performed on:**

Amica Star Tracker (AST) electronics - QM Model

**Contractor:**

INFN Roma – CARSO Trieste

**Contractor responsible:**

P.Trampus (CARSO Trieste)  
C.Gargiulo (INFN-Roma)

**Test responsible:**

Three different subjects - CARSO, INFN-Roma and S.E.R.M.S.- have participated to this test. The applicable procedure has been written by INFN-Roma (C.Gargiulo) **Document No. AMS\_02\_AST\_050106\_rev1.**

Roles and responsibilities of the participating subjects are defined as follow:

- Test conduction has been responsibility of INFN-Roma.  
INFN-Roma personnel units at SERMS have contributed to the setup and disassembly phases, verifying thermal sensor locations and failure. They have the responsibility to issue procedure variation sheet (PVS).
- AST electronics switch-on/switch-off operations, monitoring and functional tests have been performed by CARSO personnel units. Recorded data from AST electronics functional test are under responsibility of CARSO.
- SERMS has been responsible for the test facility and the measurement hardware (thermal vacuum chamber, thermal sensors, pressure sensors, data acquisition chain).
- SERMS has been responsible of the environmental parameters and AST electronics temperature measurements along the whole test. Recorded data have been handled only by SERMS qualified personnel. They regularly monitored the test execution.

The SERMS project manager responsible for the test has been Ing. Serena Borsini.

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### **APPLICABLE LAWS AND RULES**

#### **CUSTOMER TEST PROCEDURE**

*AMS\_02 STAR TRACKER - THERMAL BALANCE / THERMAL VACUUM TEST PLAN*  
Document No. AMS\_02\_AST\_050106\_rev1, 21/02/06 and subsequent PVSs

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**S.E.R.M.S Lab. - INTERNAL TEST PROCEDURE**  
**09-PT-TVM-A01-26APR2K6.doc**  
**THERMOVACUUM TEST PROCEDURE**

**D.L. 19 settembre 1994, n.626**

Attuazione delle direttive 89/391/CEE, 89/654/CEE, 89/655/CEE, 89/656/CEE, 90/269/CEE, 90/270/CEE, 90/394/CEE e 90/679/CEE riguardanti il miglioramento della sicurezza e della salute dei lavoratori sul luogo di lavoro, e successive modifiche;

**MIL-HDBK-831 23 Aprii 1999**

Preparation of Test Reports (guidance only);

**UNI -10653 – November 1997**

Quality product technical documentation (guidance only) ;

**UNI CEI EN45001**

general criterion for test laboratory operation;

**UNI CEI 70001**

norm certificate test laboratory terms and definitions;

**UNI CEI 70011**

guide for test result presentation;

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**SERMS FACILITY - QUALITY ASSURANCE INFORMATION**

EQUIPMENT	MANUFACTURER	P/N	S/N	ACCURACY	NEXT CAL DATE	REMARKS
TV chamber with pressure measurement and temperature acquisition system	Angelantoni	HVT-2000 MC	10107	NA	Conformance certificate (first installation) is dated 12/01/2006	Detailed technical informations can be provided by the Facility.
THERMAL RIBBONS	MINCO	S651		Class B tolerance	13/11/ 2006	None
Pressure sensor	LEYBOLD	ITR090 – No.12090	Part number: 2809	±15% for reading in the range of $1 \times 10^{-8}$ ... $1 \times 10^{-2}$ mbar after 5 min. os stabilization	13/11/ 2006	None
THERMAL SENSOR – thin film elements	MINCO	S651PD	NA	$100\Omega \pm 0,12 \%$	28/02/2007	None

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EQUIPMENT	MANUFACTURER	P/N	S/N	ACCURACY	NEXT CAL DATE	REMARKS
DAQ	NATIONAL INSTRUMENTS	6036E	11DAA16	INPUT 16 bit 200kS/sec $\pm 0,05$ to $\pm 10$ V	6/04/2007	none
Feed troughs plugs	POSITRONICS			NA	10/01/2007	Visual inspection
Flat Cable	RS			NA	15/03/2007	Visual inspection

### TEST SUMMARY

The actual procedure adopted in the test is schematically presented in Figure 1. Eight intermediate cycles have been executed.

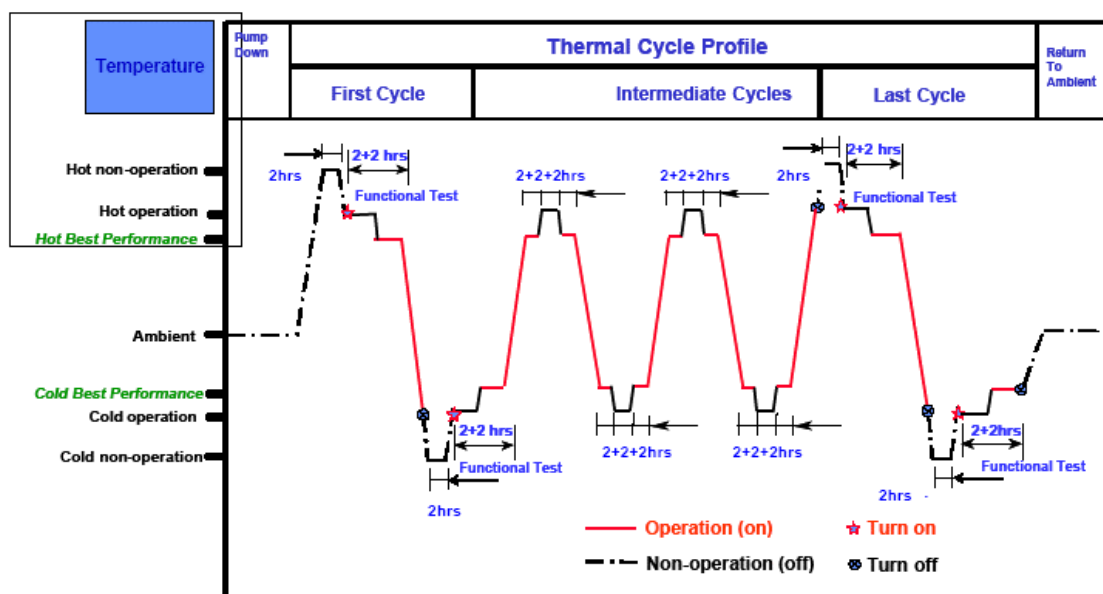


FIGURE 1 – TEST TEMPERATURE PROFILE

The cycle temperature values are listed in the following table; the intermediate cycles are eight.

	HOT	COLD
Non-operation	85°C	-45°C
Operation	60°C	-35°C
Best-Performance	40°C	-25°C

It derives from the approved reference profile on the customer procedure: Document No. AMS\_02\_AST\_050106\_rev1, 21/02/06 and the related PVS approved by the AMS Thermal Working Group.

Due to the duration of the test, the full set of recorded data has been splitted for data handling purposes in sub-phases: the depressurization phase (chamber evacuation), 8 sub-phases (each corresponding to a temperature cycle) and the Return to Ambient phase.



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### **TEST RESULTS**

The AST electronics qualification model has been tested at S.E.R.M.S. in the Thermal Vacuum Chamber (TVC) during the period March 14<sup>th</sup> – March 23<sup>th</sup> 2006.

The test has been performed according to the test profile shown in the previous section of this report. CARSO experts have attended the test and operated the AST electronics during the switch-on/switch-off and functional test phases.

No malfunctioning has been observed in the S.E.R.M.S equipment: the environmental parameters in the TVC matched the customer requests and were continuously recorded.

The AST electronics temperatures have been continuously monitored in 5 locations and their values recorded during the whole test period. The complete set of recorded data can be provided on customer request. In this report will be summarized only the most significant test data.

All the commitments of S.E.R.M.S. with the customer have been fulfilled and the test can be declared successfully completed for what concerns the items under S.E.R.M.S. responsibility.

The complete step-by-step procedure followed and wrote during the test is attached as annex to this report.

### **REMARKS**

#### **REMARK #1**

Initially the stabilization criteria that should be used was the same of AMS\_02 EHV and RHV Bricks Thermal Test Specification: when  $\Delta T / \Delta t \leq 1^{\circ}\text{C/hr}$  is reached and maintained at least for 1 hour, then the T shall stabilize for at least 2 hours.

During the test this criteria has been modified: when  $\Delta T / \Delta t \leq 1^{\circ}\text{C/hr}$  (evaluated on a period of ten minutes) is reached then the T shall stabilize for at least 2 hours.

Regarding this procedure change a PVS has been issued and reported as Annex to this report.

#### **REMARK# 2**

During the first phase of the test (Hot phase of the first cycle) only the cold plate temperature control has been enabled. Before the hot stabilization phase of the first cycle also the shroud temperature control has been enabled in order to obtain on the DUT the temperature values required by the test procedure.

### **TEST DIARY**

DUT incoming:	march 10, 2006;
Test Set-Up:	march 14, 2006;
TVC test:	march 14, 2006 – march 23, 2006.
Disassembly:	march 24, 2006.

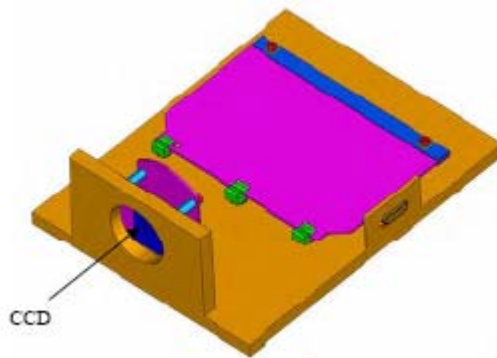
### **TEST SET-UP**

The Amica Star Tracker electronics was tested in the Thermo Vacuum Chamber fixed to the lower cold plate by the thermal vacuum cycling test fixture made of Aluminium alloy. CCD (Charged Coupled Device) was oriented in order to point to a light spot used for functional test.

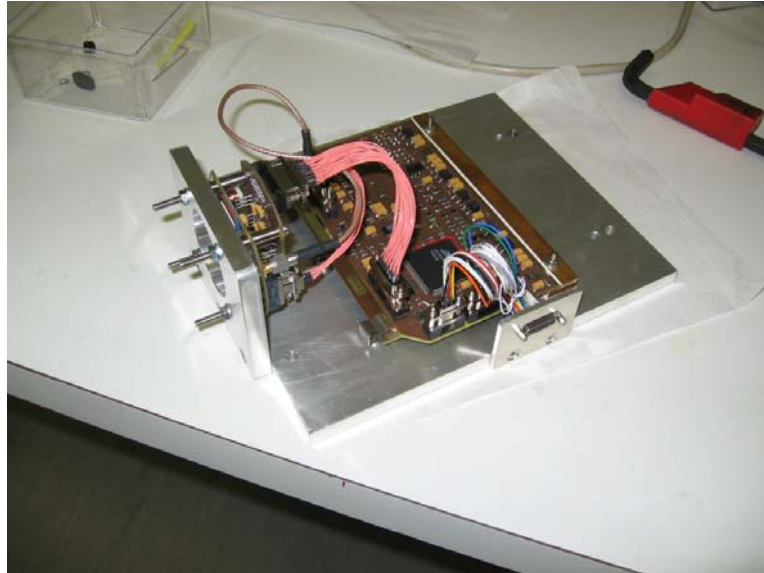
During the set up phase the main activities performed have been:

- unpackage and cleaning of the electronic board, the Aluminium fixture and the screws needed to place the fixture on cold plate and to fix the electronic board on it.
- thermal sensors positioning in the TVC
- thermal sensors positioning on the electronics

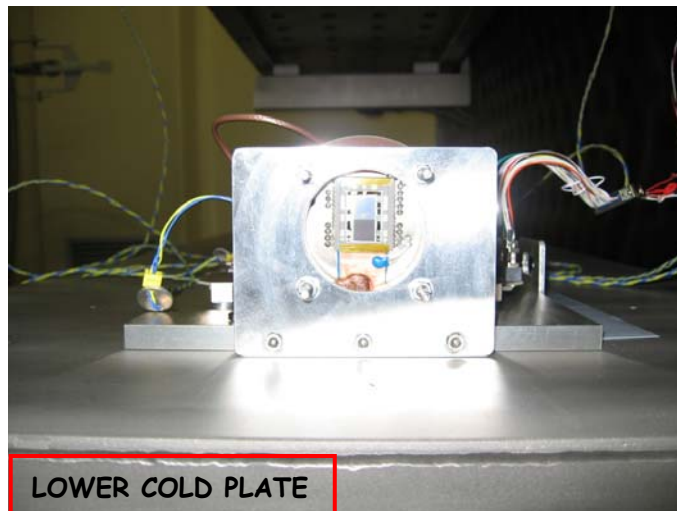
### **UNPACKAGE AND POSITIONING**



**FIGURE 2 –TEST SET-UP OF THE AST ELECTRONICS (PC BOARD AND CCD)**

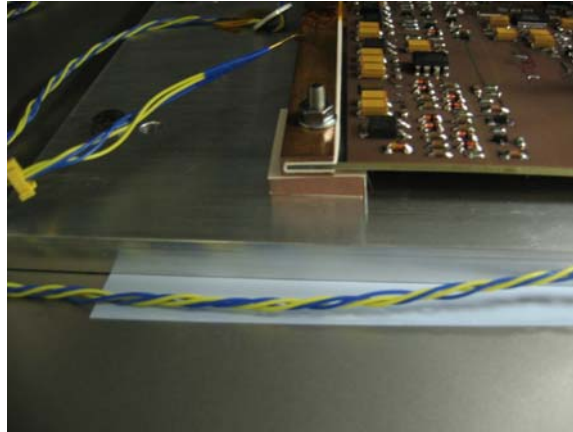


**FIGURE 3 – HARDWARE POSITIONING ON THE AL FIXTURE.**



**FIGURE 4 – AST POSITIONING INSIDE THE THERMO-VACUUM CHAMBER ON THE LOWER COLD PLATE.**

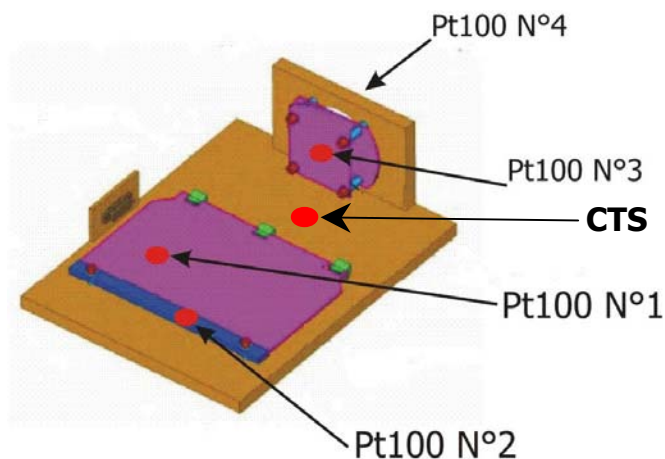
The Aluminium alloy fixture reproduce the same I/F condition that are in the flight configuration; in order to have a good thermal connection between the fixture and the cold plate, a layer of thermal conductive material (Cho-Term) was placed between the fixture and plate.



**FIGURE 5 - DETAIL OF CHO-TERM LAYER PLACED BETWEEN THE AL FIXTURE AND THE COLD PLATE.**

### **THERMAL SENSORS POSITIONING ON THE DUT**

A total of 5 Thermal Sensors (PT100 sensors) have been installed on the AST electronics by S.E.R.M.S. personnel under the direction of INFN-Roma and CARSO personnel. Four sensors to monitor the temperature of the electronics in different points during the test. One sensor was installed on the AL fixture to drive the cold plate and shroud temperature during the test (CTS-Control Temperature Sensor).



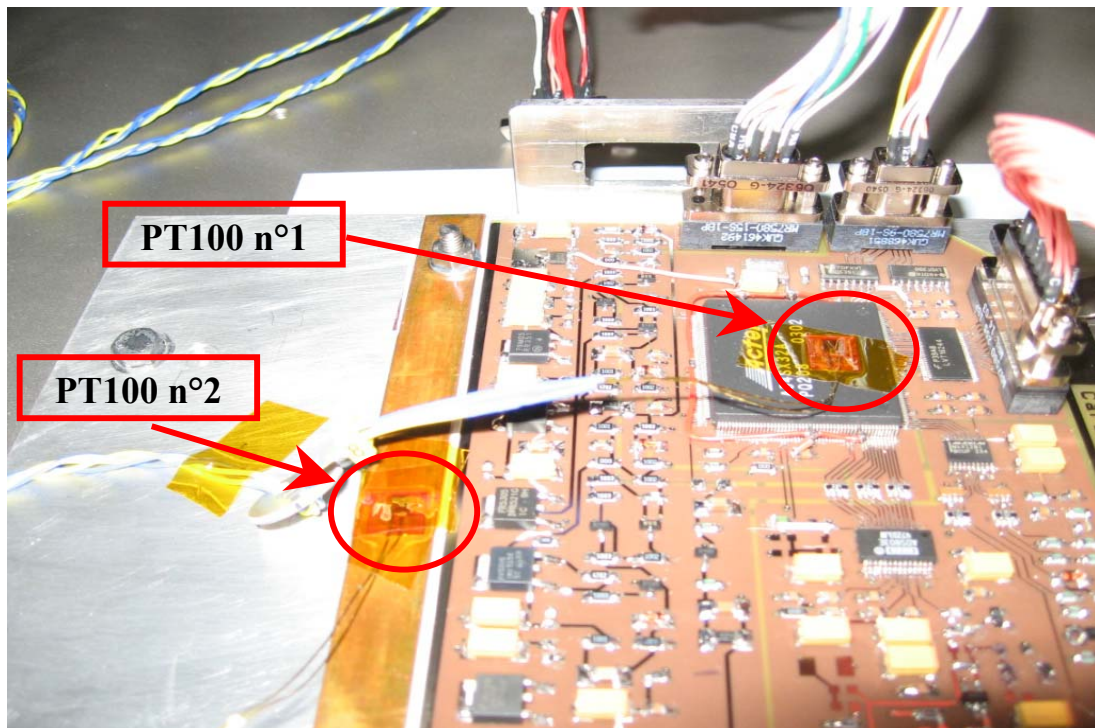
**FIGURE 6 – TEMPERATURE SENSORS POSITIONING ON THE DUT.**

The temperature sensors are installed as specified in the next table:

Sensor number	Location	Position
1	ASTCE Electronic board 3	On ACTEL fpga
2	ASTCE Electronic board 3	On Copper strip on PCB Board
3	ASTCD ccd board 2	On PCB Board
4	ASTCC ccd board 1	On Copper plate

The sensors used are the chamber sensors and they are installed using Kapton tape.  
After positioning, all sensors have been tested to verify possible failures after installation .

In the following are presented the photographs of all sensors after positioning.



**FIGURE 7 – PT100 N°1 AND 2 POSITIONING.**



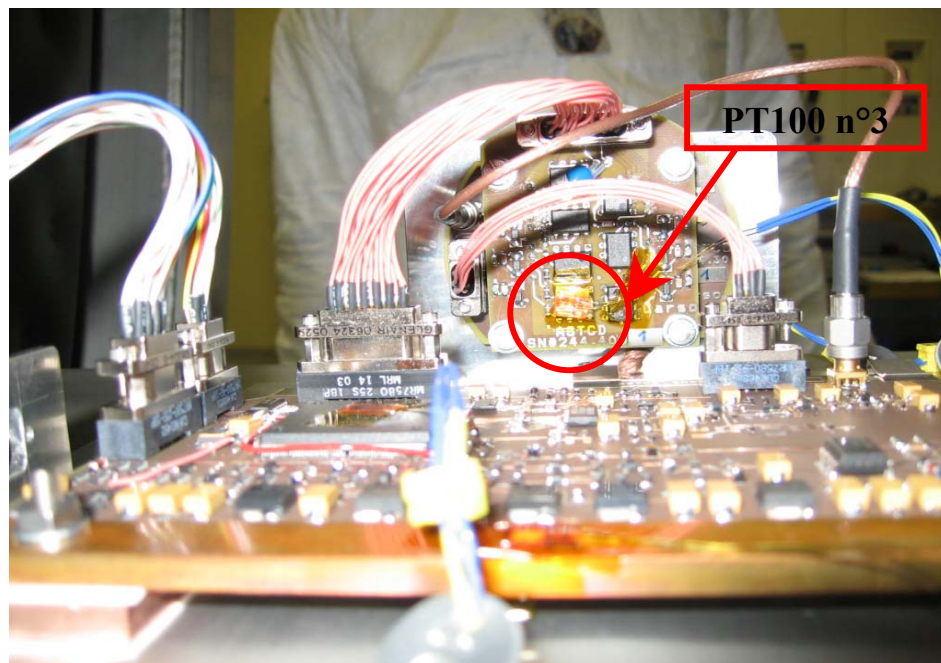
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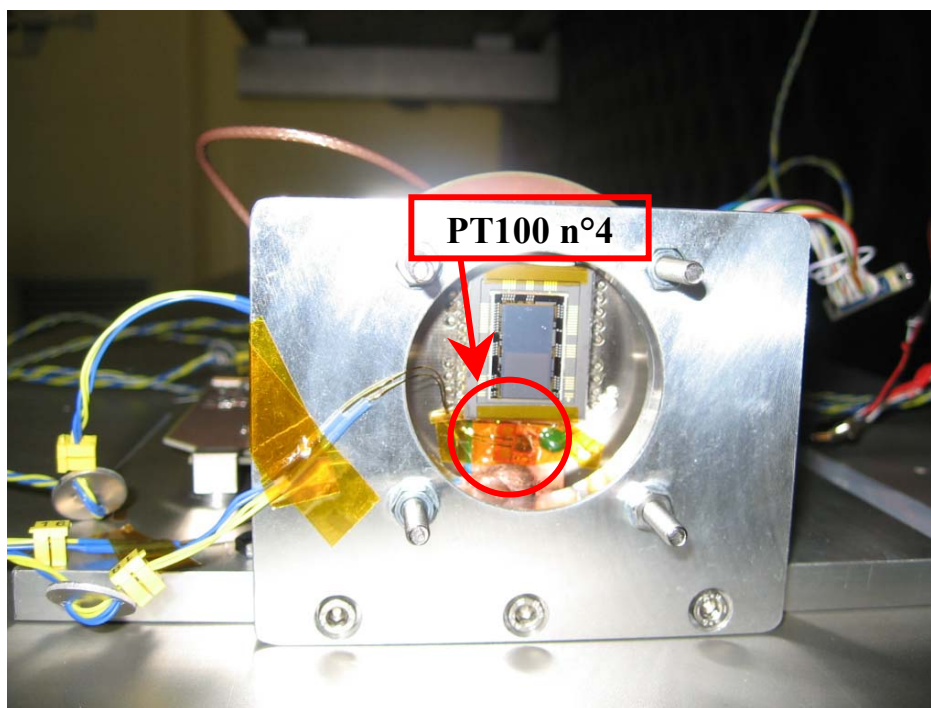
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**FIGURE 8 – PT100 N° 3 POSITIONING.**



**FIGURE 9 – PT100 N° 4 POSITIONING.**

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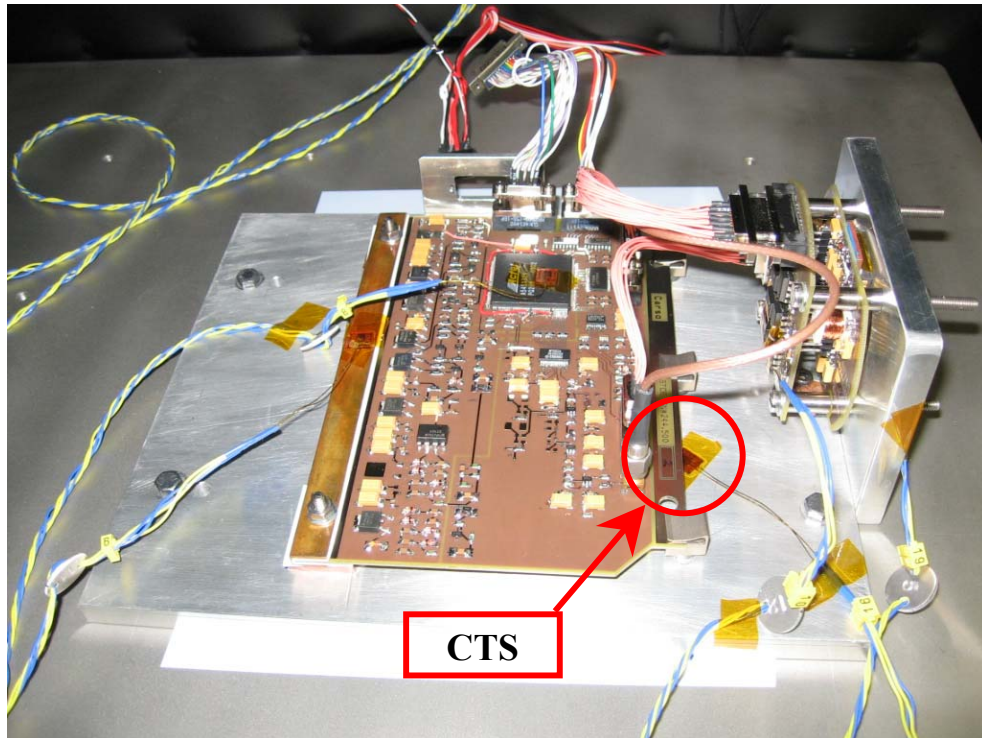
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**FIGURE 10 – CONTROL TEMPERATURE SENSOR POSITIONING.**

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### **TEST GRAPHS**

All the control and environmental parameters in the TVC have been continuously monitored and recorded during the test. The AST electronics temperatures have been continuously monitored in 5 locations and their values recorded during the whole test period.

In this section, the graphs summarizing the temporal evolution of all measured quantities during the whole test period are reported.

A more detailed set of graphs has been also produced for the evacuation phase and the test sub-phases as defined beforehand in the test summary section. These graphs have been reported in Chamber evacuation, in Annex 01 to Annex 08 and Post Eight phase annex to this report.

Hereby the S.E.R.M.S. guarantees that:

- the handling of the test data has been done only by qualified members of the S.E.R.M.S. staff.
- all graphs presented in this report and its annex are a truthful representation of the recorded data and have been solely produced by the S.E.R.M.S. engineer in charge of the test.

The complete set of recorded data can be provided on customer request.

More detailed graphs relative to specific measurements can be produced on customer request.



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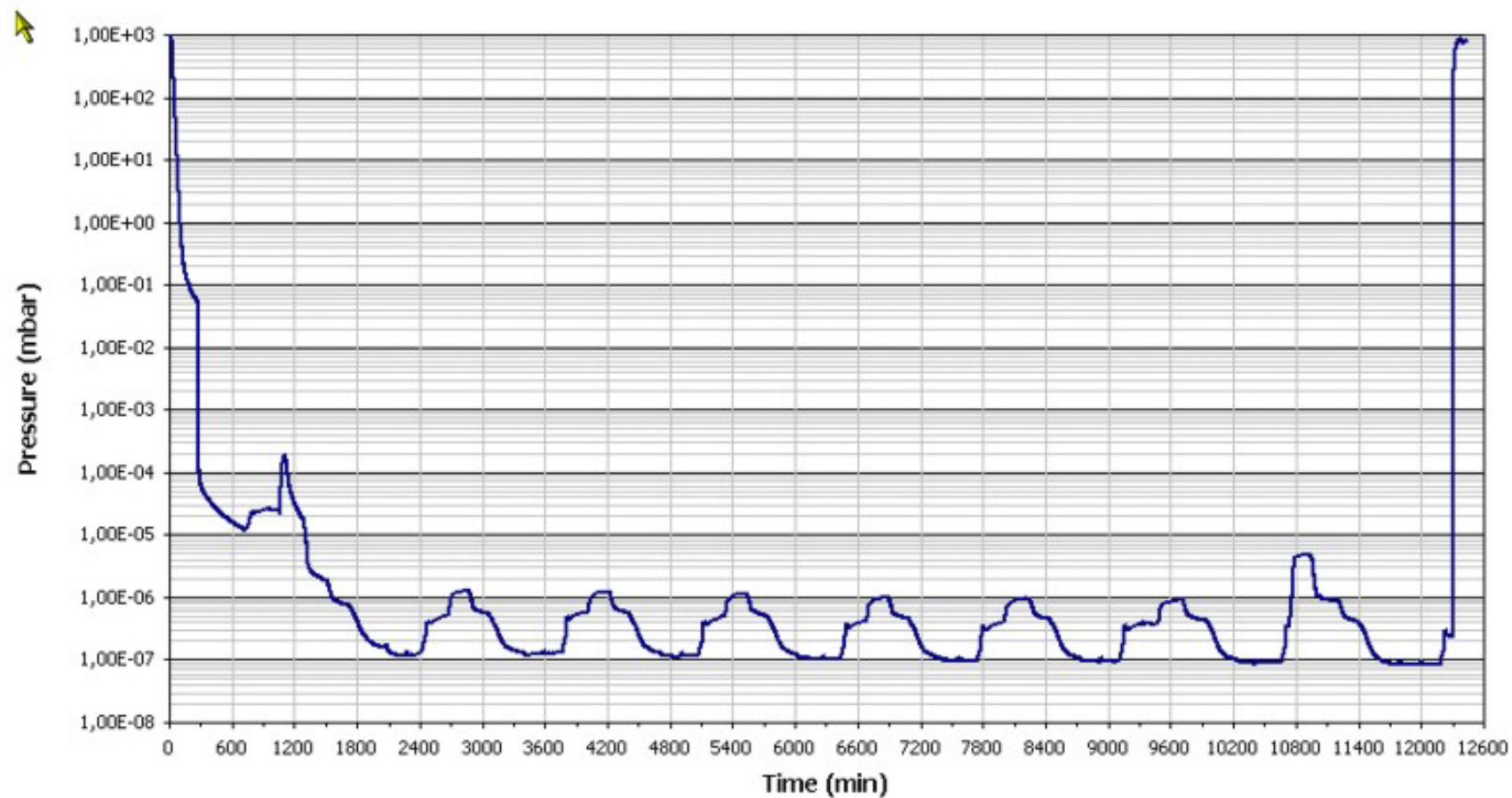


FIGURE 11 – PRESSURE PROFILE OF THE TEST. THE PEAKS CORRESPOND TO THE HOT PHASE OF EACH CYCLE.

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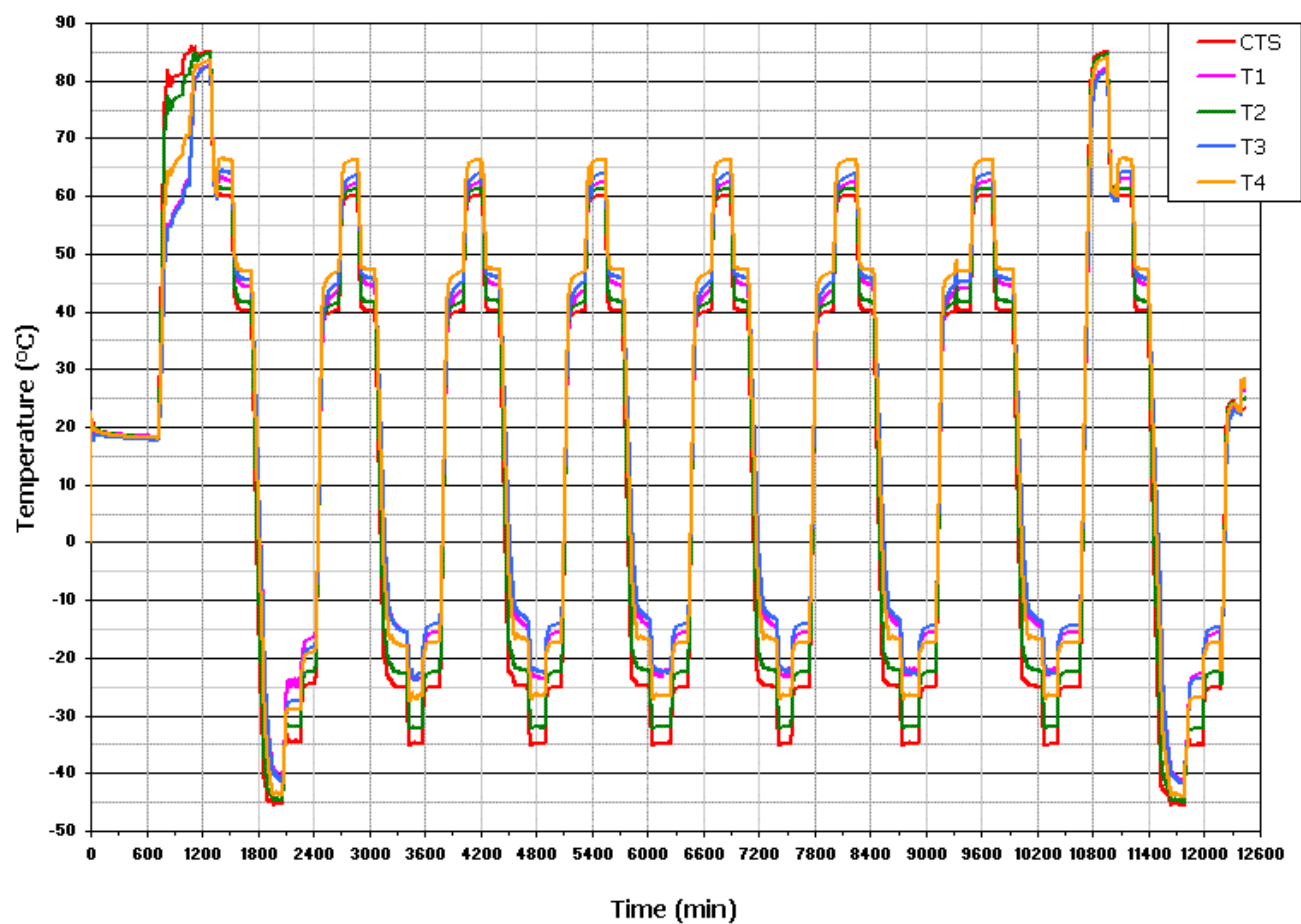


FIGURE 12 – SENSORS TEMPERATURE PROFILE.

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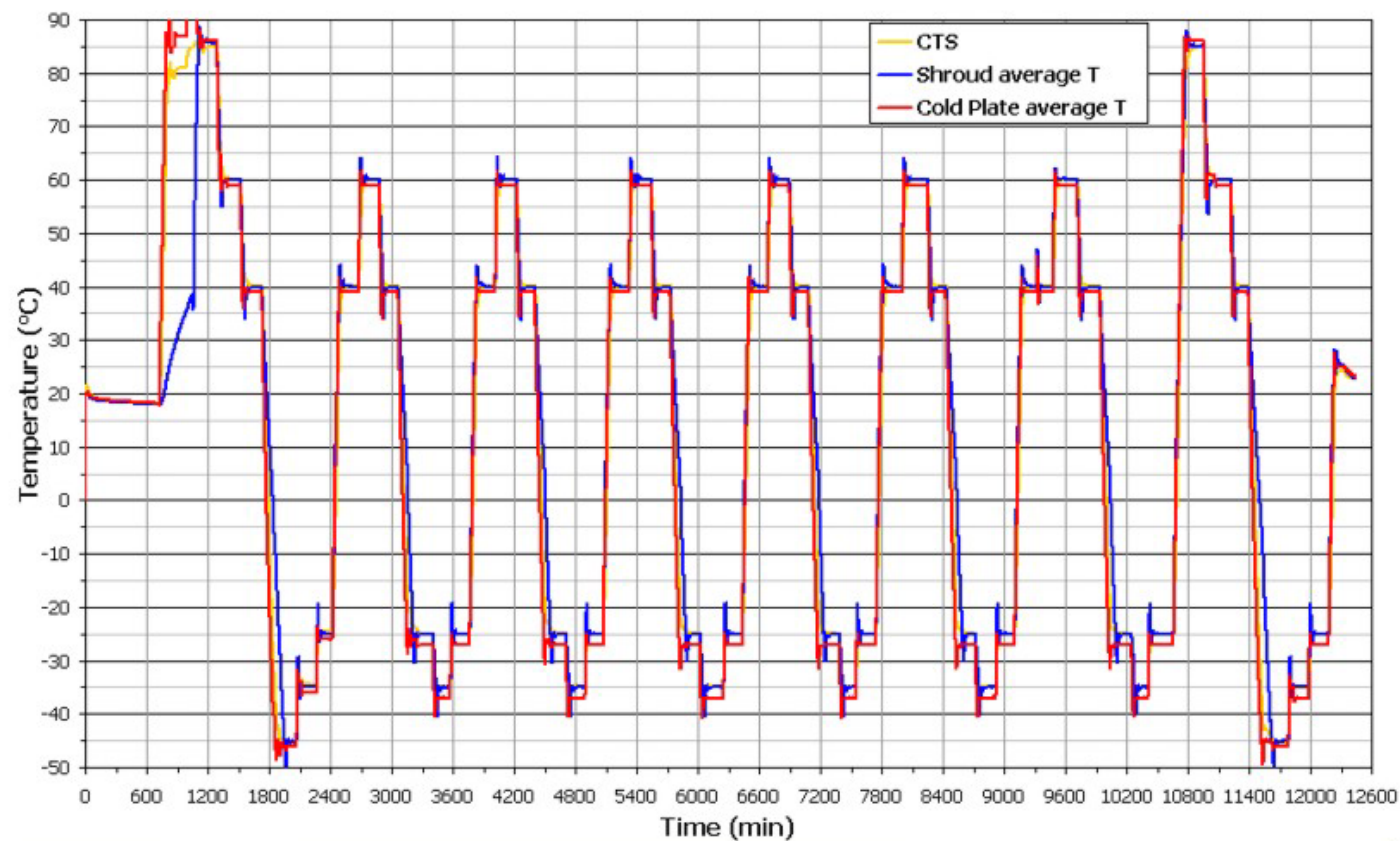


FIGURE 13 – COLD PLATES AND SHROUD TEMPERATURE PROFILE COMPARED WITH THE CTS TEMPERATURE PROFILE.

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### **ANNEX LIST**

- CHAMBER EVACUATION
- ANNEX 01- FIRST CYCLE
- ANNEX 02- SECOND CYCLE
- ANNEX 03 – THIRD CYCLE
- ANNEX 04 – FOURTH CYCLE
- ANNEX 05 – FIFTH CYCLE
- ANNEX 06 – SIXTH CYCLE
- ANNEX 07 – SEVENTH CYCLE
- ANNEX 08 – EIGHTH CYCLE
- POST EIHGTH ANNEX- RETURN TO AMBIENT CONDITIONS PHASE
- PROCEDURE VARIATION SHEETS
- STEP BY STEP PROCEDURE

### **END OF DOCUMENT**